viii. 10 cm Aperture Insertion Dipole

Each of the 6 insertion regions have a 100 mm coil diameter dipole in each ring on both sides of the intersection region, for a total of 24 dipoles. These dipoles, termed "D0", initiate the beam crossover. Although they contain only a single beam, the relatively large aperture is required to accommodate the large beam size due to the low-beta configuration, as well as variations in beam crossing angles, and collisions between unequal species. The design field, 3.52 T, is about the same as the arc dipole, and the identical superconducting cable is used in a similar, single-layer coil design. Even though the two D0 magnets on one side of the crossover are contained in a common cryostat, the corners of the containment vessels of the two yokes almost touch; in fact, this constrains the yoke outer diameter. Like the arc dipole, the yoke serves as a collar for the coils, and is held together by keys at the horizontal midplane after the halves are pressed together.

Basic Design Parameters

Table 1-24 summarizes the preliminary design parameters. The cable used is the same as that in the arc dipoles, see Tables 1-2 and 1-3 with all Kapton CI insulation. In order to achieve good field uniformity at low field, a single layer five-block coil design is needed. It is designated D0GA653D with 16, 10, 6, 5 and 3 turns per block, respectively, from the midplane to the pole for a total of 40 turns in each coil half. The coil design features symmetric wedges to ease construction. With the constraint on the yoke outer diameter mentioned above, the gap between coil and iron, which is occupied by an RX630 molding, is limited to 10 mm in thickness to minimize the flux return path reluctance. With fixed gap, minimum cross-talk between the two side-by-side magnets is obtained by optimizing the coil diameter; it was found that unwanted harmonics at maximum design field are minimized with a coil aperture of 100 mm. To maximize the effectiveness of this relatively small aperture, the D0 magnets are curved, with a sagitta of 7.6 mm. To simplify interconnections, there will be two types of D0, with opposite curvatures.

Figure 1-14 shows a POISSON model of one quadrant of the coil and yoke. The helium flow channels are the same as in the arc magnets, 30.1 mm in diameter, and the superconductor bus aperture is also the same, a 31.75 mm square. The keys for holding the upper and lower halves together and the pins for lamination pairs are stainless steel. The

Table 1-24. Basic Design Parameters for the 10 cm Aperture RHIC Insertion Dipole

Coil i.d.	100	mm
Number of turns per pole	40	
Number of magnets, total	24	
Magnetic length	3.6	m
Iron inner diameter	139.4	mm
Sagitta	7.6	mm
Spacer thickness	10	mm
Iron outer diameter	310	mm
Shell thickness	6.35	mm
Operating temperature	4.6	K
Design current	5.0	kA
Design field	3.52	T
Computed quench current	6.5	kA
Computed quench field	4.42	T
Stored energy @ design current	210	kJ
Field margin	26%	
Transfer function		
@ low current	0.746	T/kA
@ design current	0.701	T/kA
Allowed Design harmonics @ 31 mm		
design field	< 1	
saturation induced $b_2^{/}$, $b_{2i}^{/}$, $i > 1$	< 3, < 1	
Non-allowed harmonics @ 31 mm		
cross-talk induced $b_1^{/}$, $b_{2i+1}^{/}$, $i > 0$	< 0.5, < 0.3	

helium bypass holes are positioned and suppressor holes added to minimize saturation-induced harmonics. The containment vessel (also not shown) is formed similarly to that of the arc dipole from a stainless steel shell of 6.35 mm thickness.

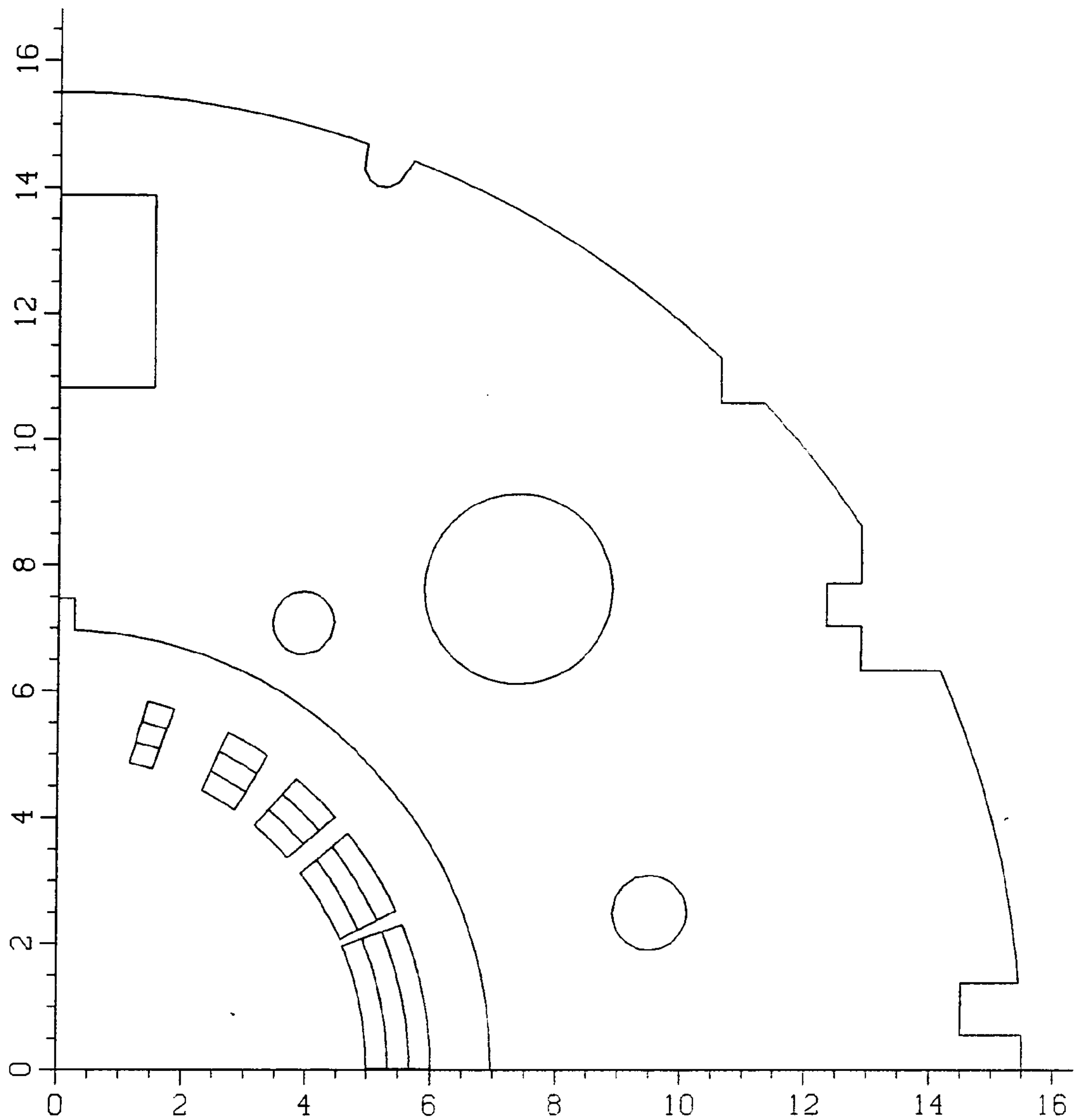

Fig. 1-14. POISSON model of one quadrant of coil and yoke (dimensions in cm).